

MILITARY SPECIFICATION

CAPACITORS, FIXED, GLASS DIELECTRIC,

GENERAL SPECIFICATION FOR

This specification is mandatory for use by all Departments and Agencies of the Department of Defense.

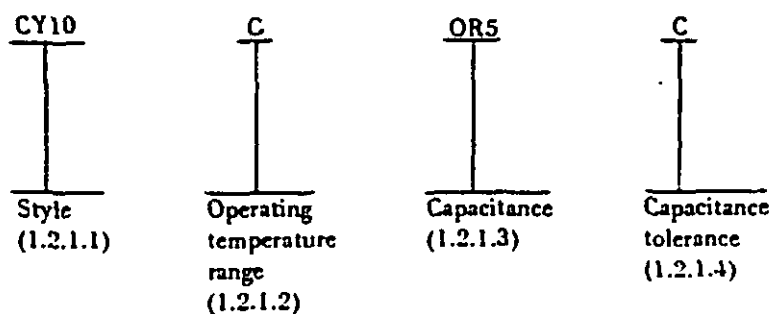
INACTIVE FOR DESIGN AFTER DATE OF
 THIS SPECIFICATION. USE MIL-C-23269.

1. SCOPE

1.1 Scope. This specification covers the general requirements for glass-dielectric, fixed capacitors enclosed in glass cases, suitably protected against high humidity.

1.2 Classification.

1.2.1 Type designation. The type designation shall be in the following form, and as specified (see 3.1 and 6.1):



1.2.1.1 Style. The style is identified by the two-letter symbol "CY" followed by a two-digit number; the letters identify glass-dielectric, fixed capacitors, and the number identifies the shape and dimensions of the capacitor.

1.2.1.2 Operating temperature range. The operating temperature range is identified by a single letter in accordance with table I.

TABLE I. Operating temperature range.

Symbol	Operating temperature range
C	°C -55 to +125

1.2.1.3 *Capacitance.* The nominal capacitance value expressed in picofarads (pF) is identified by a three-digit number; the first two digits represent significant figures and the last digit specifies the number of zeros to follow. When fractional values of a pF are required; the letter "R" shall be used to indicate the decimal point and the succeeding digits of the group shall represent significant figures. Example: 1R5 indicates 1.5 pF.

1.2.1.4 *Capacitance tolerance.* The capacitance tolerance is identified by a single letter in accordance with table II.

TABLE II. *Capacitance tolerance.*

Symbol	Capacitance tolerance (\pm)
C	0.25 pF
D	0.50 pF
F	1%
G	2%
J	5%

2. APPLICABLE DOCUMENTS

2.1 The following documents, of the issue in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein.

SPECIFICATIONS

FEDERAL

QQ-S-571 Solder; Tin Alloy; Lead-Tin Alloy; and Lead Alloy.

MILITARY

MIL-C-23269 Capacitors, Fixed, Glass Dielectric. Established Reliability.
General Specification For.
MIL-C-39028 Capacitors. Packaging of.
MIL-C-45662 Calibration System Requirements.

(See supplement 1 for list of applicable detail specifications.)

STANDARDS

MILITARY

MIL-STD-105 Sampling Procedures and Tables for Inspection by Attributes.
MIL-STD-202 Test Methods for Electronic and Electrical Component Parts.
MIL-STD-1276 Leads, Weldable, for Electronic Component Parts.

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publications. The following document forms a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids shall apply.

OFFICIAL CLASSIFICATION COMMITTEE

Uniform Freight Classification Rules.

(Application for copies should be addressed to the Official Classification Committee, One Park Avenue, at 33rd Street, New York, N. Y. 10016.)

3. REQUIREMENTS

3.1 Detail requirements for individual capacitor styles. Detail requirements or exceptions applicable to individual styles of capacitors shall be as specified in the detail specifications listed in supplement 1 to this specification. In the event of any conflict between requirements of this specification and the detail specifications, the latter shall govern (see 6.1).

3.2 Qualification. Capacitors furnished under this specification shall be a product which has been tested and has passed the qualification tests specified in 4.4, and has been listed on or approved for listing on the applicable qualified products list (see 6.2).

3.3 Material. The material shall be as specified herein. However, when a definite material is not specified, a material shall be used which will enable the capacitors to meet the performance requirements of this specification. Acceptance or approval of any constituent material shall not be construed as a guaranty of the acceptance of the finished product.

3.3.1 Solder. Solder for electrical connections shall be in accordance with QQ-S-571. In no case shall the solder start to melt at a temperature of less than 200°C.

3.3.2 Soldering flux. Rosin or rosin and alcohol shall be used as a flux. Consideration will be given to the use of other soldering fluxes only when adequate evidence is presented to indicate that the proposed flux is equally suitable and noncorrosive.

3.4 Design and construction. Capacitors shall be of the design, construction, and physical dimensions specified (see 3.1).

3.4.1 Capacitor element. The capacitor element shall consist of alternate layers of glass dielectric and electrode.

3.4.2 Case. Each capacitor shall be enclosed in a glass case which will protect the capacitor element from the effects of prolonged exposure to high humidities under all the test conditions specified herein.

3.4.3 Connections. Electrical connections shall not depend upon the terminals being clamped between a metallic member and an insulating material other than the glass material. Such connections shall be securely made, mechanically and electrically, with the capacitor element by soldering, welding, or mechanical means, in such a manner that the normal movements of the terminal leads will not result in strain, wear, or damage to the capacitor element, case, or coating.

3.5 Dielectric withstanding voltage. Capacitors shall withstand the direct current (dc) potential specified in 4.6.2 without damage, arcing, or breakdown.

3.6 Barometric pressure. Capacitors shall withstand the dc potential specified in 4.6.3 without damage, arcing, or breakdown.

3.7 Insulation resistance. When measured as specified in 4.6.4, the insulation resistance shall exceed 100,000 megohms.

3.8 Capacitance. When measured as specified in 4.6.5, the capacitance shall be within the tolerance shown in the type designation (see 3.1).

3.9 Dissipation factor. When measured as specified in 4.6.6, the dissipation factor shall be not more than 0.001.

3.10 Quality factor (Q). When measured as specified in 4.6.7, the Q shall be not less than the value shown on figure 1, unless otherwise specified (see 3.1).

3.11 Shock (specified pulse). When capacitors are tested as specified in 4.6.8, there shall be no intermittent contacts, open- or short-circuiting, nor evidence of arcing or mechanical damage.

3.12 Vibration, high frequency. When capacitors are tested as specified in 4.6.9, there shall be no intermittent contacts, open- or short-circuiting, nor evidence of mechanical damage.

3.13 Temperature cycling and immersion. When tested as specified in 4.6.10, capacitors shall meet the following requirements:

- (a) Visual examination – There shall be no evidence of corrosion or mechanical damage that will affect life or serviceability.
- (b) Dielectric withstanding voltage – There shall be no evidence of damage, arcing, or breakdown.
- (c) Insulation resistance – Not less than 100,000 megohms.
- (d) Capacitance – Change not more than 0.5 percent of the nominal value or 0.5 pF, whichever is greater, from the initial value obtained when measured as specified in 4.6.5.
- (e) Dissipation factor – Not to exceed 0.001.

3.14 Moisture resistance. When tested as specified in 4.6.11, capacitors shall meet the following requirements:

- (a) Visual examination – There shall be no evidence of corrosion or mechanical damage that will affect life or serviceability.
- (b) At 90 to 95 percent relative humidity:
 - (1) Insulation resistance – 1,000 megohms, minimum.
- (c) At 50 ± 5 percent relative humidity:
 - (1) Dielectric withstanding voltage – There shall be no evidence of damage, arcing, or breakdown.
 - (2) Insulation resistance – Not less than 100,000 megohms.
 - (3) Capacitance – Change not more than 0.5 percent of the nominal value or 0.5 pF, whichever is greater, from the initial value obtained when measured as specified in 4.6.5.
 - (4) Dissipation factor – Not to exceed 0.001.

3.15 Life. When tested as specified in 4.6.12.1, capacitors shall meet the following requirements, as applicable:

- (a) Visual examination – There shall be no evidence of corrosion or mechanical damage that will affect life or serviceability.
- (b) At 25°C:
 - (1) Insulation resistance – Not less than the value specified (see 3.1).
 - (2) Capacitance – Change not more than 1 percent of the nominal value or 0.5 pF, whichever is greater, unless otherwise specified (see 3.1), from the initial value obtained when measured as specified in 4.6.5.
 - (3) Dissipation factor – Shall not exceed the value specified (see 3.1).

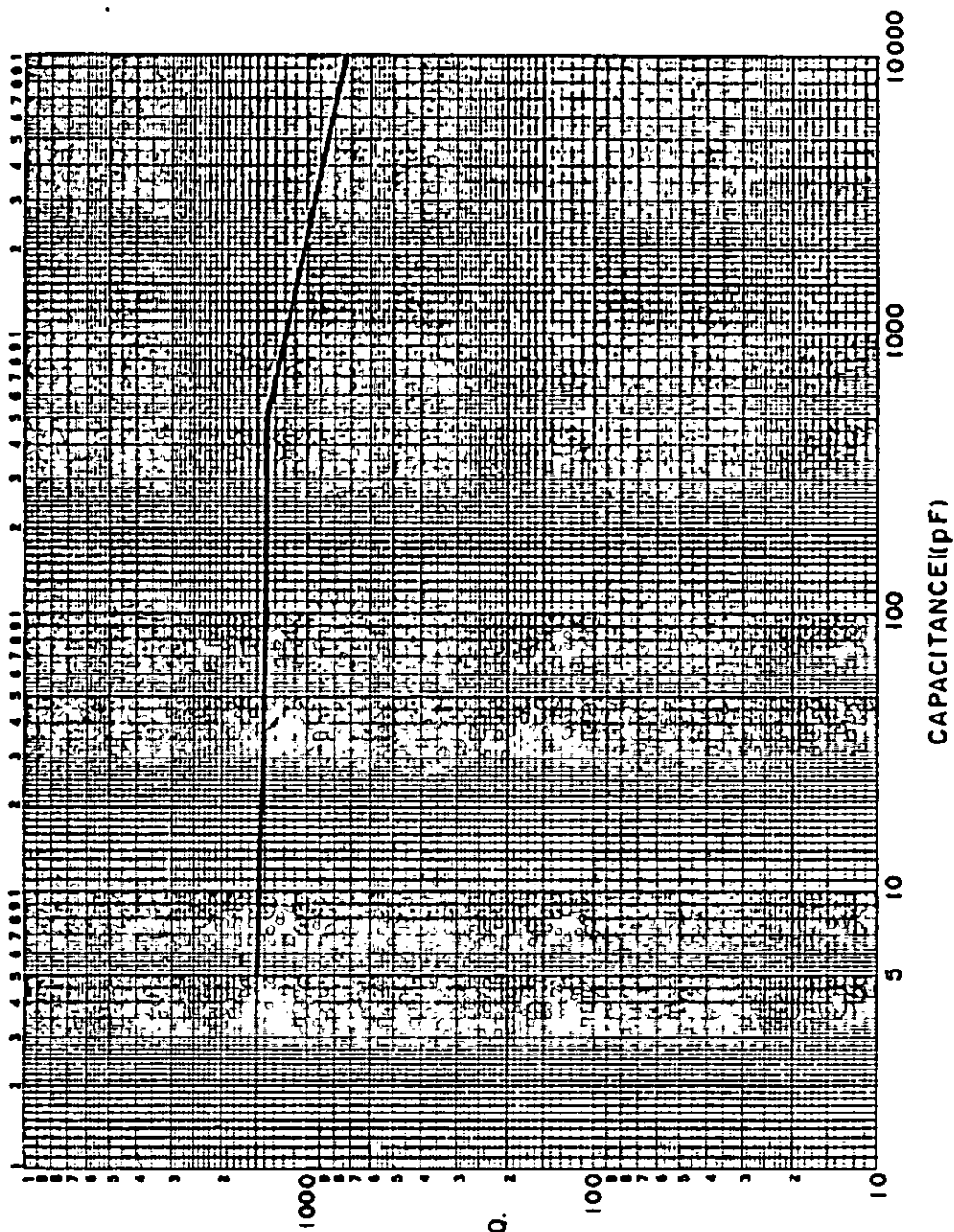


FIGURE 1. Quality factor (Q) at 1 megahertz (MHz).

(c) At 125°C:

- (1) Insulation resistance — Not less than the value specified (see 3.1).
- (2) Capacitance — When measured as specified in 4.6.12.1, change not more than 1 percent of the nominal value or 0.5 pF, whichever is greater, unless otherwise specified (see 3.1), from the initial 125°C value.
- (3) Dissipation factor — Shall not exceed the value specified (see 3.1).

3.15.1 *Performance check.* When tested as specified in 4.6.12.2.1, capacitors shall meet the following requirements:

- (a) Visual examination — There shall be no evidence of corrosion or mechanical damage that will affect life or serviceability.
- (b) Insulation resistance — Not less than the value specified (see 3.1).
- (c) Capacitance — Change not more than 1 percent of the nominal value or 0.5 pF, whichever is greater, unless otherwise specified (see 3.1), from the initial value obtained when measured as specified in 4.6.5.
- (d) Dissipation factor — Shall not exceed the value specified (see 3.1).

3.15.2 *Continuation test.* When tested as specified in 4.6.12.2.2, capacitors shall meet the requirements specified in 3.15.

3.16 *Solderability.* When capacitors are tested as specified in 4.6.13, the dipped surface of the leads shall be at least 95 percent covered with a new, smooth, solder coating. The remaining 5 percent of the lead surface shall show only small pinholes or rough spots; these shall not be concentrated in one area. Bare base metal and areas where the solder dip failed to cover the original coating are indications of poor solderability, and shall be cause for failure. In case of dispute, the percent of coverage with pinholes or rough spots shall be determined by actual measurement of these areas, as compared to the total area.

3.17 *Terminal strength.* When capacitors are tested as specified in 4.6.14, terminals shall not loosen or rupture, and there shall be no permanent damage to the terminals or seal.

3.18 *Temperature coefficient and capacitance drift.* When measured as specified in 4.6.15, the temperature coefficient and capacitance drift shall be within the limits specified (see 3.1).

3.19 *Marking.* Capacitors shall be marked with the type designation and the manufacturer's name or code symbol. There shall be no space between the symbols which comprise the type designation. If lack of space requires it, the type designation may appear on two lines. In this event, the type designation shall be divided between the operating temperature range and capacitance symbols, as shown in the following example:

CY10C
OR5C

When lack of space prohibits the marking of the type designation on two lines, the type designation may appear on three lines. In this event, the type designation shall be divided after the two-letter symbol "CY" and between the operating temperature range and capacitance symbols, as shown in the following example:

CY
10C
OR5C

Marking shall remain legible after all tests.

3.20 *Workmanship.* Capacitors shall be processed in such a manner as to be uniform in quality and shall be free from pits, corrosion, cracks, chips, and other defects that will affect life or serviceability.

3.20.1 *Terminals.* Terminals shall be hot-solder-dipped or so coated that soldering can be readily accomplished.

3.20.2 *Welding.* Surfaces to be welded shall be clean and free from oxides, greases, and other harmful material. Welds shall be of ample size and good fusing, and shall be free from all harmful defects.

4. QUALITY ASSURANCE PROVISIONS

4.1 *Responsibility for inspection.* Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.1.1 *Test equipment and inspection facilities.* Test and measuring equipment and inspection facilities of sufficient accuracy, quality and quantity to permit performance of the required inspection shall be established and maintained by the supplier. The establishment and maintenance of a calibration system to control the accuracy of the measuring and test equipment shall be in accordance with MIL-C-45662.

4.2 *Classification of inspections.* The inspections specified herein are classified as follows:

- (a) Qualification inspection (see 4.4).
- (b) Quality conformance inspection (see 4.5).

4.3 *Inspection conditions and methods.*

4.3.1 *Inspection conditions.* Unless otherwise specified herein, all inspections shall be performed in accordance with the test conditions specified in the "GENERAL REQUIREMENTS" of MIL-STD-202.

4.3.2 *Methods.* Unless otherwise specified herein, all visual examinations shall be performed without magnification other than that required to correct the eyesight. Axial-radial lead type capacitors shall be tested with the leads bent into the axial position.

4.4 *Qualification inspection.* Qualification inspection shall be performed at a laboratory acceptable to the Government (see 6.2) on sample units produced with equipment and procedures normally used in production.

4.4.1 *Sample size.* The number of capacitors to be subjected to qualification inspection shall be as specified in the appendix to this specification.

4.4.2 *Inspection routine.* The sample shall be subjected to the inspections specified in table III, in the order shown. All sample units shall be subjected to the inspection of group I. The sample shall then be divided as specified in table III for groups II to V inclusive.

4.4.3 *Failures.* Failures in excess of those permitted in table III will be cause for refusal to grant qualification.

TABLE III. Qualification inspection.

Examination or test	Requirement paragraph	Test method paragraph	Number of sample units to be inspected	Number of failures permitted ^{1/}		
<i>Group I ^{2/}</i>						
Visual and mechanical examination (internal): Material, design, construction and workmanship.	3.1, 3.3 to 3.4.3, incl, and 3.20 to 3.20.2, incl	4.6.1	} 2	} 0		
Visual and mechanical examination (external): Physical dimensions, marking ^{3/} and workmanship	3.4, and 3.19, to 3.20.2, incl	4.6.1				
Dielectric withstanding voltage	3.5	4.6.2	} ^{4/} 61 or ^{5/} 62	} 1		
Barometric pressure	3.6	4.6.3				
Insulation resistance	3.7	4.6.4				
Capacitance	3.8	4.6.5.1				
Dissipation factor (DF)	3.9	4.6.6				
Quality factor (Q)	3.10	4.6.7	} 12	} 2		
<i>Group II</i>						
Shock (specified pulse)	3.11	4.6.8			} 12	} 1
Vibration, high frequency	3.12	4.6.9				
Temperature cycling and immersion	3.13	4.6.10				
<i>Group III</i>						
Moisture resistance	3.14	4.6.11	12	1		
<i>Group IV</i>						
Life	3.15	4.6.12.1	24	1		
<i>Group V</i>						
Solderability	3.16	4.6.13	} 12	} 1		
Terminal strength	3.17	4.6.14				
Temperature coefficient and capacitance drift .	3.18	4.6.15				

^{1/} A sample unit having one or more defects shall be considered as a single failure.

^{2/} With the exception of the internal visual and mechanical examination, all tests of this group are nondestructive tests.

^{3/} Marking will be considered a failure only if it becomes illegible as a result of any of the tests.

^{4/} For single-type submission, 1 additional sample unit is included in each sample of 63 sample units to permit substitution for failure permitted.

^{5/} For combined-type submission, 2 additional sample units (1 of the highest and 1 of the lowest capacitance value) are included in each sample of 64 sample units to permit substitution for the permitted failure (either the highest or lowest capacitance value).

4.4.4 Retention of qualification. To retain qualification, the supplier shall forward a report at 6-month intervals to the qualifying activity. The qualifying activity shall establish the initial reporting date. The report shall consist of:

- (a) A summary of the results of the tests performed for inspection of product for delivery, group A indicating as a minimum the number of lots that have passed and the number that have failed. The results of tests of all reworked lots shall be identified and accounted for.
- (b) A summary of the results of tests performed for qualification verification inspection group B, including the number and mode of failures. The summary shall include results of all qualification verification inspection tests performed and completed during the 6-month period. If the summary of the test results indicates nonconformance with specification requirements, and corrective action acceptable to the qualifying activity has not been taken, action may be taken to remove the failing product from the qualified products list.

Failure to submit the report within 30 days after the end of each 6-month period may result in loss of qualification for the product. In addition, to the periodic submission of inspection data, the supplier shall immediately notify the qualifying activity at any time during the 6-month period that the inspection data indicates failure of the qualified product to meet the requirements of this specification.

In the event that no production occurred during the reporting period, a report shall be submitted certifying that the company still has the capabilities and facilities necessary to produce the item. If during two consecutive reporting periods there has been no production, the manufacturer may be required, at the discretion of the qualifying activity, to submit a representative product of each style to testing in accordance with the qualification inspection requirements.

4.5 Quality conformance inspection .

4.5.1 Inspection of product for delivery. Inspection of product for delivery shall consist of group A inspection.

4.5.1.1 Inspection lot. An inspection lot shall consist of all capacitors of the same style produced under essentially the same conditions, and offered for inspection at one time.

4.5.1.2 Group A inspection. Group A inspection shall consist of the examinations and tests specified in table IV, in the order shown.

4.5.1.2.1 Sampling plan. Statistical sampling and inspection shall be in accordance with MIL-STD-105 for general inspection level II. The acceptable quality level (AQL) shall be as specified in table IV. Major and minor defects shall be as defined in MIL-STD-105.

4.5.1.2.2 Rejected lots. If an inspection lot is rejected, the supplier may rework it to correct the defects, or screen out the defective units, and resubmit for reinspection. Resubmitted lots shall be inspected using tightened inspection. Such lots shall be kept separate from new lots, and shall be clearly identified as reinspected lots.

4.5.2 Periodic inspection. Periodic inspection shall consist of group B. Except where the results of these inspections show noncompliance with the applicable requirements (see 4.5.2.1.4), delivery of products which have passed group A shall not be delayed pending the results of these periodic inspections.

TABLE IV. Group A inspection.

Examination or test	Requirement paragraph	Test method paragraph	AQL (percent defective)	
			Major	Minor
Visual and mechanical examination:		4.6.1		
Material	3.3 to 3.3.2, incl		1.0	4.0
Physical dimensions	3.4			
Design and construction (other than physical dimensions).	3.4 to 3.4.3, incl			
Marking ^{1/}	3.19			
Workmanship	3.20 to 3.20.2, incl			
Dielectric withstanding voltage	3.5	4.6.2	1.0	---
Insulation resistance	3.7	4.6.4		
Capacitance	3.8	4.6.5.2		
Dissipation factor	3.9	4.6.6		
Barometric pressure	3.6	4.6.3	2.5	---
Life (performance check)	3.15.1	4.6.12.2.1		

^{1/} Marking defects are based on visual examination only. Any subsequent electrical defects shall not be used as a basis for determining marking defects.

4.5.2.1 *Group B inspection.* Group B inspection shall consist of the tests specified in table V and shall be made on sample units selected from inspection lots which have passed the group A inspection.

TABLE V. Group B inspection.

Test	Requirement paragraph	Test method paragraph	Number of sample units to be inspected	Number of defectives permitted
Every month				
Subgroup I				
Shock (specified pulse)	3.11	4.6.8	} 12	} 2/1
Vibration, high frequency	3.12	4.6.9		
Temperature cycling and immersion	3.13	4.6.10		
Subgroup II				
Moisture resistance	3.14	4.6.11	12	2/1
Subgroup III				
Solderability	3.16	4.6.13	} 12	} 1
Terminal strength	3.17	4.6.14		
Temperature coefficient and capacitance drift ..	3.18	4.6.15.2 to 4.6.15.2.2 incl		
Every three months				
Subgroup I				
Life (continuation test)	3.15.2	4.6.12.2.2	1/24	1

^{1/} Sample units to be inspected shall be selected from sample units that have been subjected to the 250-hour performance-check test.

^{2/} If the failures exceed the total number permitted by 1, the inspection shall be rerun with the same sample size with zero failures permitted.

4.5.2.1.1 Sampling plan. The number of sample units to be inspected for each subgroup shall be selected from the first lot and from each month's and each three months' production as specified in table V. A different set of sample units shall be selected for each subgroup.

4.5.2.1.2 Defectives. If the number of defectives exceeds the number allowed in table V, the sample shall be considered to have failed.

4.5.2.1.3 Disposition of sample units. Sample units which have been subjected to group B inspection shall not be delivered on the contract or purchase order.

4.5.2.1.4 Noncompliance. If a sample fails to pass group B inspection, the supplier shall take corrective action on the materials or processes, or both, as warranted, and on all units of product which can be corrected and which were manufactured under essentially the same conditions, with essentially the same materials, processes, etc., and which are considered subject to the same failure. Acceptance of the product shall be discontinued until corrective action, acceptable to the Government, has been taken. After the corrective action has been taken, group B inspection shall be repeated on additional sample units (all inspection, or the inspection which the original sample failed, at the option of the Government). Group A inspection may be reinstituted; however, final acceptance shall be withheld until the group B reinspection has shown that the corrective action was successful. In the event of failure after reinspection, information concerning the failure and corrective action taken shall be furnished to the cognizant inspection activity and the qualifying activity.

4.5.3 Inspection of preparation for delivery. Sample packages and packs and the inspection of the preservation and packaging, packing and marking for shipment and storage shall be in accordance with the requirements of section 5 and the documents specified therein.

4.6 Methods of examinations and test.

4.6.1 Visual and mechanical examination. Capacitors shall be examined to verify that the materials, design, construction, physical dimensions, marking, and workmanship are in accordance with the applicable requirements (see 3.1, 3.3 to 3.4.3, incl, and 3.19 to 3.20.2, incl).

4.6.2 Dielectric withstanding voltage (see 3.5). Capacitors shall be tested in accordance with method 301 of MIL-STD-202. The following details shall apply:

- (a) Magnitude and nature of test potential – 200 percent of the dc rated voltage (see 3.1).
- (b) Duration of application of test voltage – Not less than 1 second nor more than 5 seconds.
- (c) Points of application of test voltage – Between the terminals.
- (d) Limiting value of surge current – Shall not exceed 50 milliamperes (ma).
- (e) Examinations after test – Capacitors shall be examined for evidence of damage, arcing, and breakdown.

4.6.3 Barometric pressure (see 3.6). Capacitors shall be tested in accordance with method 105 of MIL-STD-202. The following details shall apply:

- (a) Method of mounting – Not applicable.
- (b) Test-condition letter – B.
- (c) Tests during subjection to reduced pressure – 150 percent of the dc rated voltage (see 3.1) shall be applied between the terminals for not less than 1 second nor more than 5 seconds.
- (d) Examinations after test – Capacitors shall be examined for evidence of damage, arcing, and breakdown.

4.6.4 *Insulation resistance (see 3.7).* Capacitors shall be tested in accordance with method 302 of MIL-STD-202. The following details shall apply:

- (a) Test potential – A dc potential equal to the dc rated voltage (see 3.1).
- (b) Points of measurement – From terminal to terminal. (Condensed moisture may be removed by a blast of air.)

4.6.5 *Capacitance (see 3.8).*

4.6.5.1 *For qualification inspection.* capacitors shall be tested in accordance with method 305 of MIL-STD-202. The following details shall apply:

- (a) Test frequency – 1 MHz \pm 200 kHz when the capacitance is 1,000 pF or smaller, and 1 kHz \pm 100 Hz when the capacitance is greater than 1,000 pF.
- (b) Limit of accuracy – Shall be \pm 0.2 percent or \pm 0.2 pF, whichever is greater.

4.6.5.2 *For quality conformance inspection.* Capacitors shall be tested in accordance with method 305 of MIL-STD-202. The following detail shall apply:

- (a) Test frequency – 1 kHz \pm 100 Hz, or 1 MHz \pm 200 kHz. Capacitance measurements made at 1 kHz shall be referred to measurements made at a frequency of 1 MHz.

4.6.6 *Dissipation factor.* Dissipation factor shall be measured at a frequency of 1 kHz \pm 100 Hz. Measurement accuracy shall be within \pm 2 percent or 0.0005, whichever is greater, for dissipation factor and within \pm 5 Hz for frequency (see 3.9).

4.6.7 *Quality factor (Q) (see 3.10).* Capacitors shall be tested in accordance with method 306 of MIL-STD-202. The following detail shall apply:

- (a) Test frequency – 1 MHz \pm 200 kHz.

4.6.8 *Shock (specified pulse) (see 3.11).* Capacitors shall be tested in accordance with method 213 of MIL-STD-202. The following details shall apply:

- (a) Mounting – Capacitors shall be rigidly mounted by the body to the test apparatus in such a manner that the mounting method does not damage the capacitors.
- (b) Test-condition letter – I (100 G).
- (c) Measurements during shock – During shock, an electrical measurement shall be made to determine intermittent contacts or open- or short-circuiting. The accuracy of the detecting equipment shall be sufficient to detect any interruption with a duration of 0.5 millisecond or greater.
- (d) Examination after shock – Capacitors shall be visually examined for evidence of arcing or mechanical damage.

4.6.9 *Vibration, high frequency (see 3.12).* Capacitors shall be tested in accordance with method 204 of MIL-STD-202. The following details and exceptions shall apply:

- (a) Mounting – Capacitors shall be rigidly mounted by the body to the test apparatus in such a manner that the mounting method does not damage the capacitor.
- (b) Test-condition letter – B.
- (c) Measurements during vibration – During the last cycle in each direction, an electrical measurement shall be made to determine intermittent contacts or open- or short-circuiting. The accuracy of the detecting equipment shall be sufficient to detect any interruption with a duration of 0.5 millisecond or greater.
- (d) Examination after test – Capacitors shall be visually examined for evidence of mechanical damage.

4.6.10 *Temperature cycling and immersion (see 3.13).*

4.6.10.1 *Temperature cycling.* Capacitors shall be tested in accordance with method 102 of MIL-STD-202. The following details and exception shall apply:

- (a) Test-condition letter – C.
- (b) Measurements before and after cycling – Not applicable.

4.6.10.2 *Immersion.* Following temperature cycling, capacitors shall be tested in accordance with method 104 of MIL-STD-202. The following details shall apply:

- (a) Test-condition letter – B.
- (b) Time after final cycle allowed for measurements – Shall not exceed 30 minutes. Surface moisture shall be removed by circulating air at room temperature, or wiping with a clean dry cloth, or both.
- (c) Examinations and measurements after final cycle – Capacitors shall be visually examined for evidence of corrosion or mechanical damage; the dielectric withstanding voltage, insulation resistance, capacitance, and dissipation factor shall then be measured as specified in 4.6.2, 4.6.4, 4.6.5, and 4.6.6, respectively.

4.6.11 *Moisture resistance (see 3.14).* Capacitors shall be tested in accordance with method 106 of MIL-STD-202. The following details and exceptions shall apply:

- (a) Mounting – Except during examinations and measurements, capacitors shall be securely fastened by normal means to rigidly supported terminals, so spaced that the length of each lead between support and capacitor body will be $1/2 \pm 1/8$ inch.
- (b) Initial measurements – Not applicable.
- (c) Polarization and load – Not applicable.
- (d) Final measurements – The insulation resistance shall be measured as specified in 4.6.4 at a temperature of $25^\circ \pm 5^\circ\text{C}$ and a relative humidity of 90 to 95 percent. Between 4 and 24 hours after this measurement, capacitors shall be visually examined for evidence of corrosion or mechanical damage; the dielectric withstanding voltage, insulation resistance, capacitance, and dissipation factor shall then be measured as specified in 4.6.2, 4.6.4, 4.6.5, and 4.6.6, respectively, at a temperature of $25^\circ \pm 5^\circ\text{C}$ and a relative humidity of 50 ± 5 percent.

4.6.12 *Life (see 3.15).*

4.6.12.1 *For qualification inspection.* Capacitance shall be measured as specified in 4.6.3 at a temperature of $125^\circ \pm 4.0^\circ\text{C}$. The capacitors shall then be subjected to 150 percent of the dc rated voltage (see 3.1) for 2,000 hours at a temperature of $125^\circ \pm 4.0^\circ\text{C}$. The surge current shall not exceed 50 ma. The insulation resistance, capacitance, and dissipation factor shall be measured as specified in 4.6.4, 4.6.5, and 4.6.6, respectively, at a temperature of $125^\circ \pm 4.0^\circ\text{C}$. The capacitors shall then be returned to the inspection conditions specified in 4.3, and the insulation resistance, capacitance, and dissipation factor shall be measured as specified in 4.6.4, 4.6.5, and 4.6.6, respectively. Capacitors shall then be visually examined for evidence of corrosion or mechanical damage.

4.6.12.2 *For quality conformance inspection.*

4.6.12.2.1 *Performance check.* Capacitors shall be tested as specified in 4.6.12.1, except that the duration of the test shall be 250 hours and that only the measurements at the inspection conditions specified in 4.3 need be made (see 3.15.1 and table IV).

4.6.12.2.2 *Continuation test.* Capacitors which have been subjected to the 250-hour performance-check specified in 4.6.12.2.1 shall be tested for an additional period of 1,750 hours in accordance with 4.6.12.1, with voltage applied with the same polarity as when subjected to the performance check (see 3.15.2 and table V).

4.6.13 *Solderability (see 3.16).* Capacitors shall be tested in accordance with method 208 of MIL-STD-202.

4.6.14 *Terminal strength (see 3.17).*

4.6.14.1 *Pull test.* The body of the capacitor shall be secured, and each terminal in turn shall be subjected to a gradually applied axial-pull of 5 pounds maintained at its maximum value for 5 seconds.

4.6.14.2 *Twisting test.* All terminals shall be bent through 90° at a point $1/4$ inch from the body of the capacitor, with the radius of curvature at the bend approximately $1/32$ inch. The terminals shall be clamped to within $3/64 \pm 1/64$ inch of the bend on the side between the bend and the remaining portion of the lead, away from the body. The body of the capacitor shall then be rotated about the original axis of the bent terminal through 360° in alternating directions for three such 360° rotations, at the rate of approximately 5 seconds per rotation. The capacitors shall then be examined for evidence of loosening or rupture, and damage to the terminals or seal.

NOTE: For the purpose of this test, the original axis is considered to be the axial position of all leads.

4.6.15 *Temperature coefficient and capacitance drift (see 3.18).*

4.6.15.1 *For qualification inspection.* Capacitance measurements shall be made at the following temperatures, in the order listed:

Temperatures ($^\circ\text{C}$)

25 \pm 2
 -55 \pm 0, -2
 -10 \pm 2
 25 \pm 2
 65 \pm 2
 85 \pm 2, -0
 125 \pm 2, -0
 25 \pm 2

The measurement at each temperature shall be recorded when two successive readings taken at 5-minute intervals at that temperature indicate no change in capacitance. The temperature at the time of measurement shall be measured to an accuracy of ± 1 percent of the temperature difference between the nominal test temperature and the nominal reference temperature $+0.5^\circ\text{C}$. Measurements shall be made at a frequency of 100 kHz \pm 10 MHz. The reference frequency at which measurements are made shall not drift more than ± 50 Hz during the test. An accuracy of ± 0.025 percent of nominal capacitance $+0.05$ pF shall be maintained for measurement of capacitance change.

4.6.15.1.1 *Continuous curve temperature coefficient.* As an alternate to the measurements specified in 4.6.15.1, a continuous curve of capacitance versus temperature may be produced by subjecting the capacitors to a slowly varying temperature. The temperature shall be varied from 25° to -55° to $+125^\circ$ to 25°C . A temperature sensing device shall be embedded in a dummy capacitor in a manner to assure accurate internal readings in the sample under test. Temperature shall be varied slowly enough to produce a smooth uniform curve with no loops at -55° or 125°C . Measurements shall be made at a frequency of 100 kHz \pm 10 kHz. Accuracy shall be as specified in 4.6.15.1.

4.6.15.1.2 *Temperature coefficient.* The temperature coefficient shall be computed as follows:

$$TC = \frac{(C_2 - C_1) 10^6}{(T_2 - T_1) C_1}$$

Where:

TC = temperature coefficient in parts per million per degree centigrade.

C₁ = capacitance at the middle 25°C (reference) temperature in pF.

C₂ = capacitance at test temperature in pF.

T₁ = 25°C.

T₂ = test temperature in degrees centigrade.

4.6.15.1.3 *Capacitance drift.* Capacitance drift shall be computed by dividing the greatest single difference between any two of the three values recorded at 25°C by the intermediate value recorded at 25°C.

4.6.15.2 *For quality conformance inspection.*

4.6.15.2.1 *Temperature coefficient.* Capacitance measurements shall be made as specified in 4.6.15.1 or 4.6.15.1.1, except that measurements need be made only at 25°, -55°, 25°, 125°, and 25°C, respectively. The temperature coefficient shall be computed as specified in 4.6.15.1.2.

4.6.15.2.2 *Capacitance drift.* Capacitance drift shall be computed as specified in 4.6.15.1.3.

5. PREPARATION FOR DELIVERY

5.1 Capacitors shall be prepared for delivery in accordance with MIL-C-39028.

6. NOTES

6.1 Ordering data. Procurement documents should specify the following:

- (a) Title, number, and date of this specification.
- (b) Title, number and date of the applicable detail specification, and the complete type designation (see 1.2.1 and 3.1).
- (c) Levels of preservation and packaging and packing, and applicable marking (see section 5).

6.2 Qualification. With respect to products requiring qualification, awards will be made only for products which are at the time set for opening of bids, qualified for inclusion in the applicable qualified products list whether or not such products have actually been so listed by that date. The attention of the suppliers is called to this requirement, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. The activity responsible for the qualified products list is U.S. Army Electronics Command, Fort Monmouth, New Jersey 07703; however, information pertaining to qualification of products may be obtained from Defense Electronics Supply Center, (DESC-E), 1507 Wilmington Pike, Dayton, Ohio 45401.

6.2.1 Copies of "Provisions Governing Qualification" may be obtained upon application to Commanding Officer, Naval Publications and Forms Center, 3801 Tabor Avenue, Philadelphia, Pennsylvania 19120.

6.3 Substitution data. The capacitors specified herein are not for use in design after the date of this specification. They are authorized for use in design contracts effective on or before the date of this specification, and to support existing military equipment. Capacitors specified in MIL-C-23269 are preferred for design and regardless of the failure rate designation can be used as substitutes for the inactivated capacitors of the same capacitance value, tolerance, rated voltage and temperature coefficient.

Custodians:

Army - EL
Navy - EC
Air Force - 11

Preparing activity:

Air Force - 11

Agent:

DSA - ES

Review activities:

Army - EL
Navy - EC, SH
Air Force - 11, 17, 85
DSA - ES

(Project 5910-0994)

User activities:

Army -
Navy -
Air Force - 19

APPENDIX

PROCEDURE FOR QUALIFICATION INSPECTION

10. SCOPE

10.1 This appendix details the procedure for submission of samples, with related data, for qualification inspection of capacitors covered by this specification. The procedure for extending qualification of the required sample to other capacitors covered by this specification is also outlined herein.

20. SUBMISSION

20.1 Sample.

20.1.1 *Single-type submission.* A sample consisting of 63 sample units of each type for which qualification is sought shall be submitted.

20.1.2 *Combined-type submission.* A sample consisting of 51 sample units of the highest capacitance value and 13 sample units of the lowest capacitance value, but not lower than 47 pF, in each style, dc rated voltage, and lead diameter (for styles where an optional lead diameter is allowed) for which qualification is sought shall be submitted. The sample units shall be in the J (± 5 percent) or closer capacitance tolerance. The sample units subjected to groups II and IV of table III shall be composed of the highest capacitance values represented in the submission, and the sample units subjected to groups III and V shall be composed of equal numbers of the highest and lowest capacitance values represented. The sample units shall then be subjected to the inspection for their particular group.

20.2 Test data. When tests are to be performed at a Government laboratory, prior to submission, all sample units shall be subjected to all of the tests indicated as nondestructive in table III. Each submission shall be accompanied by the test data obtained from these tests. The performance of the destructive tests by the supplier on a duplicate set of sample units is encouraged, although not required. All test data shall be submitted in duplicate.

20.3 Certification of material. When submitting sample units for qualification, the manufacturer shall submit certification, in duplicate, that the materials used in his component are in accordance with the applicable specification requirements.

20.4 Description of items. The manufacturer shall submit a detailed description of the capacitors being submitted for inspection, including materials, constructional features, and type of moisture-proofing coat at the seal, if any.

30. EXTENT OF QUALIFICATION

30.1 Single-type submission. Qualification will be restricted to the capacitance value and to capacitance tolerances equal to and broader than the capacitance tolerance submitted.

30.2 Combined-type submission. Qualification within a style and dc rated voltage will be restricted to capacitance values within the range of values submitted and, for styles where optional lead diameters are allowed, to the lead diameter submitted. Qualification of the ± 5 percent or closer capacitance tolerance automatically qualifies all other applicable capacitance tolerances. If, where applicable, 47 pF sample units are submitted, qualification will be granted for all capacitance values equal to and less than the highest value submitted.

(See Instructions – Reverse Side)

(TO DETACH THIS FORM, CUT ALONG THIS LINE.)